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APPLICATION

FOR UNITED STATES LETTERS PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, Ronald J. Hoffart, a citizen of the United States,
have invented a new and useful implement mounting system of which the following is
a specification:

1
2 **Implement Pitch-Yaw System**
3
4

5 **CROSS REFERENCE TO RELATED APPLICATIONS**

6 Two other utility patent applications are being filed with the USPTO
7 simultaneously with this application identified by Attorney Docket Numbers GROU-010
8 and GROU-011.
9

10
11 **STATEMENT REGARDING FEDERALLY**
12 **SPONSORED RESEARCH OR DEVELOPMENT**

13 Not applicable to this application.
14
15

16 **BACKGROUND OF THE INVENTION**
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19

20 **Field of the Invention**
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22 The present invention relates generally to tractor implement mounting systems
23 and more specifically it relates to an implement pitch-yaw system for effectively and
24 efficiently controlling the pitch of an implement.
25
26

1 **Description of the Related Art**

2

3 Implement mounting structures have been in use for years. Conventional
4 implement mounting structures, such as a front-end loader, allow for only lift and pitch
5 movements. A bucket or other implement is pivotally attached to the distal ends of
6 loader arms with at least one actuator directly connected between the loader arms and
7 an upper portion of the bucket for facilitating the pitch movements of the bucket.
8 However, these implement mounting structures are significantly limited in that they
9 only provide lift and pitch movements for the implement.

10

11 Improvements have been made in the art so that additional movements such as
12 roll and yaw may be accomplished for the implement utilizing additional actuators and
13 complex structures. The roll movement is typically accomplished utilizing a pair of
14 vertically orientated actuators attached to the mounting structure to roll the implement.
15 The yaw movement is typically accomplished utilizing a pair of horizontally orientated
16 actuators attached to the implement and the mounting structure.

17

18 U.S. Patent No. 6,059,048 illustrates an implement mounting arrangement
19 having "all way" operability where a pair of horizontal actuators are utilized to control
20 both the pitch and yaw of the implement. However, for the technology to work
21 properly in controlling the horizontal actuators of the '048 patent, a complex hydraulic
22 control system is required to effectively control the implement.

23

24 While these devices may be suitable for the particular purpose to which they
25 address, they are not as suitable for effectively and efficiently controlling the pitch of
26 an implement. Conventional implement mounting systems that provide "all way"
27 operability are complex, bulky and difficult to utilize in an accurate manner.

28

29 In these respects, the implement pitch-yaw system according to the present

1 invention substantially departs from the conventional concepts and designs of the prior
2 art, and in so doing provides an apparatus primarily developed for the purpose of
3 effectively and efficiently controlling the pitch of an implement.

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2 **BRIEF SUMMARY OF THE INVENTION**

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4 In view of the foregoing disadvantages inherent in the known types of
5 implement support systems now present in the prior art, the present invention provides
6 a new implement pitch-yaw system construction wherein the same can be utilized for
7 effectively and efficiently controlling the pitch of an implement.

8

9 The general purpose of the present invention, which will be described
10 subsequently in greater detail, is to provide a new implement pitch-yaw system that has
11 many of the advantages of the implement support systems mentioned heretofore and
12 many novel features that result in a new implement pitch-yaw system which is not
13 anticipated, rendered obvious, suggested, or even implied by any of the prior art
14 implement support systems, either alone or in any combination thereof.

15

16 To attain this, the present invention generally comprises a first yaw actuator and
17 a second yaw actuator attached between an implement pivotally attached to a support
18 structure and a connecting member slidably attached to the support structure, and a
19 pitch actuator attached between the connecting member and the support structure. The
20 extension/retraction of the pitch actuator moves the yaw actuators accordingly thereby
21 creating the desired pitch movement for the implement.

22

23 There has thus been outlined, rather broadly, the more important features of the
24 invention in order that the detailed description thereof may be better understood, and
25 in order that the present contribution to the art may be better appreciated. There are
26 additional features of the invention that will be described hereinafter and that will form
27 the subject matter of the claims appended hereto.

28

29 In this respect, before explaining at least one embodiment of the invention in

1 detail, it is to be understood that the invention is not limited in its application to the
2 details of construction and to the arrangements of the components set forth in the
3 following description or illustrated in the drawings. The invention is capable of other
4 embodiments and of being practiced and carried out in various ways. Also, it is to be
5 understood that the phraseology and terminology employed herein are for the purpose
6 of the description and should not be regarded as limiting.

7
8 A primary object of the present invention is to provide an implement pitch-yaw
9 system that will overcome the shortcomings of the prior art devices.

10
11 A second object is to provide an implement pitch-yaw system for effectively
12 and efficiently controlling the pitch of an implement.

13
14 Another object is to provide an implement pitch-yaw system that provides a
15 simple solution for providing both pitch and yaw to an implement.

16
17 An additional object is to provide an implement pitch-yaw system that
18 accurately controls the pitch-yaw of an implement.

19
20 A further object is to provide an implement pitch-yaw system that does not
21 require complex hydraulic control systems to control the movement of horizontal
22 actuators.

23
24 Other objects and advantages of the present invention will become obvious to the
25 reader and it is intended that these objects and advantages are within the scope of the
26 present invention.

27
28 To the accomplishment of the above and related objects, this invention may be
29 embodied in the form illustrated in the accompanying drawings, attention being called

1 to the fact, however, that the drawings are illustrative only, and that changes may be
2 made in the specific construction illustrated and described within the scope of the
3 appended claims.
4

1

2 **BRIEF DESCRIPTION OF THE DRAWINGS**

3

4 Various other objects, features and attendant advantages of the present
5 invention will become fully appreciated as the same becomes better understood when
6 considered in conjunction with the accompanying drawings, in which like reference
7 characters designate the same or similar parts throughout the several views, and
8 wherein:

9

10 FIG. 1 is an upper perspective view of the present invention.

11

12 FIG. 2 is a top view of the present invention with the implement pitch rearward.

13

14 FIG. 3 is a top view of the present invention with the implement pitch forward.

15

16 FIG. 4 is a side view of the present invention with the implement pitch
17 rearward.

18

19 FIG. 5 is a side view of the present invention with the implement pitch forward.

20

21 FIG. 6 is a top view of the present invention with the implement pitch rearward
22 with the yaw at an angle.

23

24 FIG. 7 is a top view of the present invention with the implement pitch rearward
25 with the yaw at an angle.

26

27 FIG. 8 is a flowchart illustrating the overall functionality of the present
28 invention.

29

1 FIG. 9 is a block diagram illustrating the hydraulic connections within the
2, present invention.

3

4

DETAILED DESCRIPTION OF THE INVENTION

A. Overview

Turning now descriptively to the drawings, in which similar reference characters denote similar elements throughout the several views, FIGS. 1 through 9 illustrate an implement pitch-yaw system 10, which comprises a first yaw actuator 70 and a second yaw actuator 70 attached between an implement pivotally attached to a support structure 30 and a connecting member 62 slidably attached to the support structure 30, and a pitch actuator 60 attached between the connecting member 62 and the support structure 30. The extension/retraction of the pitch actuator 60 moves the yaw actuators accordingly thereby creating the desired pitch movement for the implement.

B. Support Structure

As shown in Figures 1 through 7 of the drawings, the support structure 30 is comprised of an elongate structure. Various other structures may be utilized to construct the support structure 30 other than shown in the drawings. The support structure 30 may be attached directly to a vehicle (e.g. tractor, etc.), to a frame structure or by other means.

A cuff structure 32 at the distal end of the support structure 30 may be utilized to attach the support structure 30 to a pivot joint such as but not limited to a ball-and-socket joint. A cross member 34 is preferably attached to the support structure 30 for receiving vertical actuators for allowing manipulation of the lift and roll of the implement structure 12.

1 As shown in Figures 1 through 7 of the drawings, the support structure 30
2 preferably has a cavity for receiving the pitch actuator 60 within. However, the pitch
3 actuator 60 may be positioned external of the support structure 30.

4 5 **C. Implement Structure**

6 The implement structure 12 is pivotally attached to the support structure 30 by
7 at least one front joint 36 for preferably allowing both pitch and yaw movements to
8 occur. The implement structure 12 may be any type of an implement such as but not
9 limited to a blade, a plow, a bucket, a brush or other device. In addition, the
10 implement structure 12 may be any type of an attachment structure for removably
11 receiving an implement.1

12 13 **D. Connecting Member**

14 The connecting member 62 is slidably attached to the support structure 30 as
15 shown in Figures 1 through 7 of the drawings. A slide structure 64 is preferably
16 slidably positioned about the support structure 30 with the connecting member 62
17 attached to the slide structure 64 as best shown in Figures 4 and 5 of the drawings.

18
19 As shown in Figures 6 and 7 of the drawings, the connecting member 62
20 preferably has a winged structure. The first yaw actuator 70 and the second yaw
21 actuator 70 are attached to opposing portions of the connecting member 62 as further
22 shown in Figures 6 and 7 of the drawings. In addition, the connecting member 62
23 preferably is centered along a longitudinal axis of the support structure 30 and the
24 movement of the connecting member 62 preferably is parallel to the longitudinal axis
25 of the support structure 30.

26 27 **E. Yaw Actuators**

28 As shown in Figures 1 through 7 of the drawings, a first yaw actuator 70 and a
29 second yaw actuator 70 are attached between the implement structure 12 and the

1 connecting member 62. The first yaw actuator 70 and the second actuator are for
2 controlling the yaw position of the implement structure 12.

4 ***F. Pitch Actuator***

5 The pitch actuator 60 is attached between the connecting member 62 and the
6 support structure 30 as best shown in Figures 1 through 7 of the drawings. The pitch
7 actuator 60 preferably is positioned within the support structure 30 as shown in Figures
8 4 and 5 of the drawings, however the pitch actuator 60 may be positioned external of
9 the support structure 30.

11 The extension/retraction of the pitch actuator 60 causes the first yaw actuator
12 70 and the second yaw actuator 70 to extend/retract accordingly in a relatively
13 horizontal manner as shown in Figures 6 and 7 of the drawings. The actuators 60, 70,
14 72 may be comprised of various actuator structures such as but not limited hydraulic,
15 electric and the like.

17 ***G. Control System***

18 A control unit 40 is in communication with the first yaw actuator 70, the second
19 yaw actuator 70 and the pitch actuator 60 for controlling the same as shown in Figure 9
20 of the drawings. The control unit 40 determines which actuators 60, 70, 72 should be
21 extended/retracted according to the controls manipulated by the operator of the
22 vehicle. The control unit 40 is a valve unit when utilized with a hydraulic system 50
23 for controlling the flow of hydraulic fluid to the actuators.

25 ***H. Operation***

26 In operation, the control unit 40 determines whether a pitch forward condition
27 exists or a pitch rearward condition exists as shown in Figure 8 of the drawings. If a
28 pitch forward condition exists, the control unit 40 causes the pitch actuator 60 to
29 extend thereby causing the yaw actuators 70, 72 to simultaneously extend forwardly

1 (within directly extending the yaw actuators 70, 72) thereby causing the implement
2 structure 12 to pitch forwardly as best illustrated in Figures 3, 5 and 7 of the drawings.

3
4 If the pitch rearward condition exists, the control unit 40 causes the pitch
5 actuator 60 to retract thereby causing the yaw actuators 70, 72 to simultaneously
6 retract rearwardly (within directly extending the yaw actuators 70, 72) thereby causing
7 the implement structure 12 to pitch rearwardly as best illustrated in Figures 2, 4 and 6
8 of the drawings.

9
10 If a yaw condition exists, both of the yaw actuators 70, 72 are activated accordingly
11 to adjust the yaw of the implement structure 12. For example, if the user desires the blade
12 to be angled with the left side forward, the control unit 40 would cause the second yaw
13 actuator 70 to extend and the first yaw actuator 70 to retract (and vice-versa). It can be
14 appreciated that the adjustment of the pitch and yaw may occur simultaneously or separate.
15 In addition, the actuators may be independently operated without fluid connection to the
16 other actuators.

17
18 As to a further discussion of the manner of usage and operation of the present
19 invention, the same should be apparent from the above description. Accordingly, no
20 further discussion relating to the manner of usage and operation will be provided.

21
22 With respect to the above description then, it is to be realized that the optimum
23 dimensional relationships for the parts of the invention, to include variations in size,
24 materials, shape, form, function and manner of operation, assembly and use, are
25 deemed to be within the expertise of those skilled in the art, and all equivalent
26 structural variations and relationships to those illustrated in the drawings and
27 described in the specification are intended to be encompassed by the present invention.

1 Therefore, the foregoing is considered as illustrative only of the principles of
2 the invention. Further, since numerous modifications and changes will readily occur to
3 those skilled in the art, it is not desired to limit the invention to the exact construction
4 and operation shown and described, and accordingly, all suitable modifications and
5 equivalents may be resorted to, falling within the scope of the invention.

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